

EDSN - Edison Demonstration for SmallSat Networks

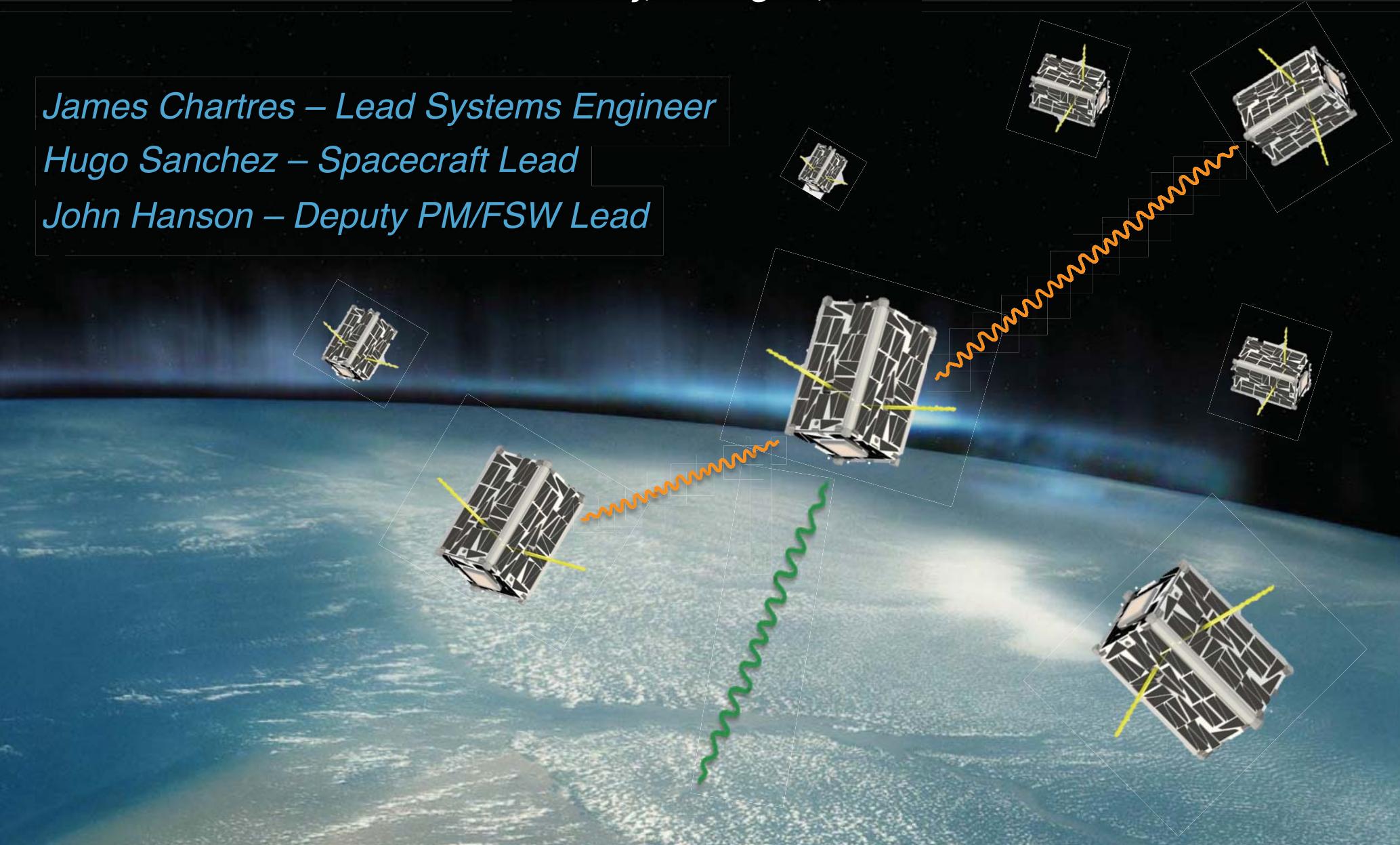
EDSN Development Lessons Learned

Tuesday, 5th August, 2014

James Chartres – Lead Systems Engineer

Hugo Sanchez – Spacecraft Lead

John Hanson – Deputy PM/FSW Lead





National Aeronautics and
Space Administration



Edison Demonstration of Smallsat Networks

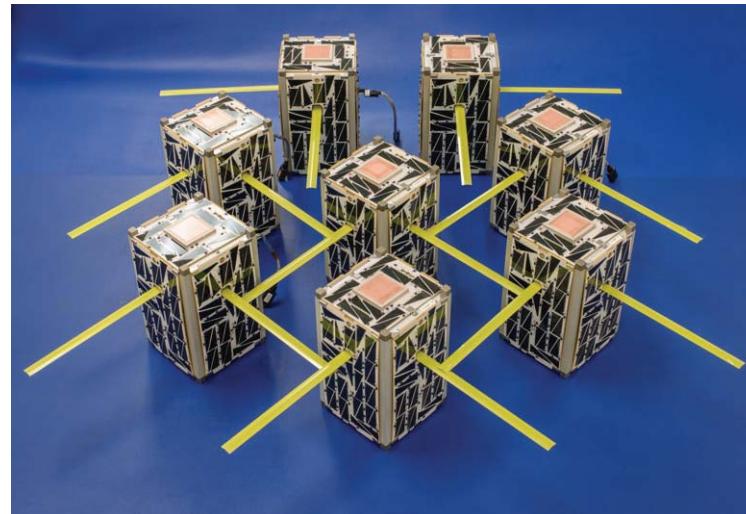
Mission Goal: Demonstrate that a swarm of satellites is capable of collecting multi-point science data and transferring the data to the ground.

Objectives:

1. Flight demonstrate one-way space-to-space data transfer whereby at least 2 satellites transfer data to a third satellite, which then transfers the data to the ground
2. Flight demonstrate a system to collect multi-point science measurements, transfer science measurements to another satellite and transfer to the ground
3. Flight demonstrate a reaction wheel based pointing system
4. Assess the viability of satellites built with Commercial Off The Shelf (COTS) components to operate for 60 days



School of Engineering





National Aeronautics and
Space Administration



Satellite Overview

3 orthogonal reaction wheels



MicroHard MHX2420
for S-band downlink



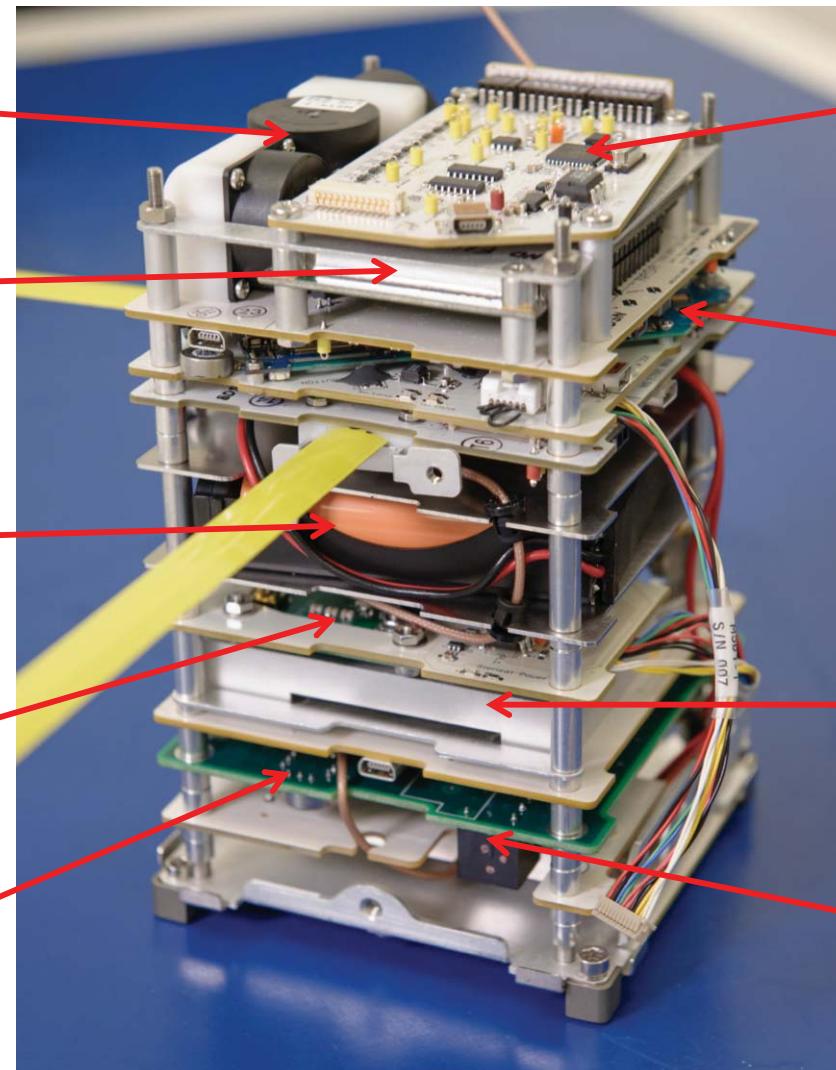
4x 18650 2800mAh
Li-Ion Batteries



StenSat UHF
transmitter



EPISEM radiation
monitoring payload



Parallax P8X32A
Propeller chip for data
& command routing

Nexus S Smartphone
as main processor

Novatel OEMV-1
GPS receiver

AstroDev Li-1 UHF
transceiver for crosslink

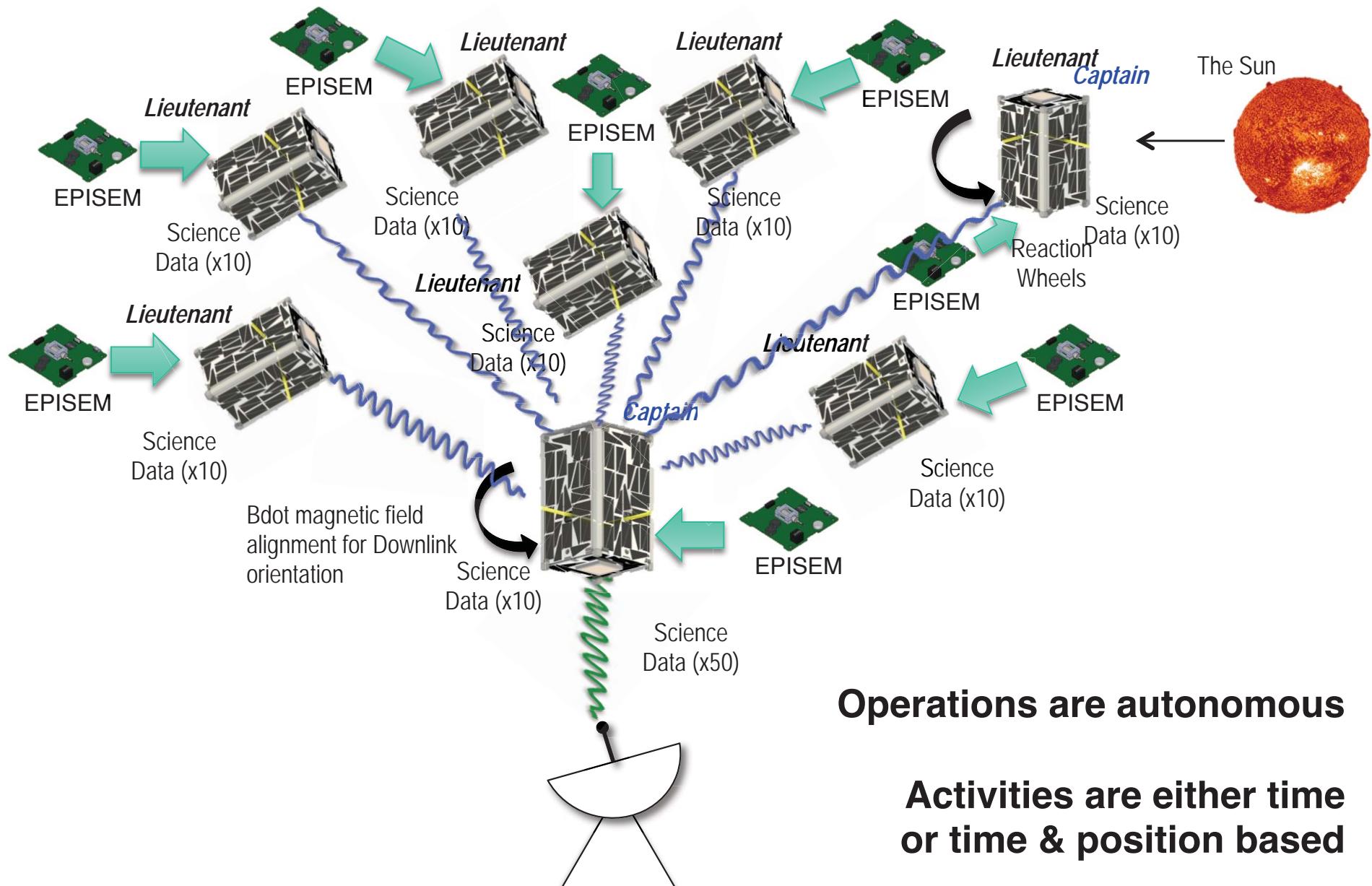
9 electrical subassemblies inter-connected
via a single backplane PCB



National Aeronautics and Space Administration



Mission Overview



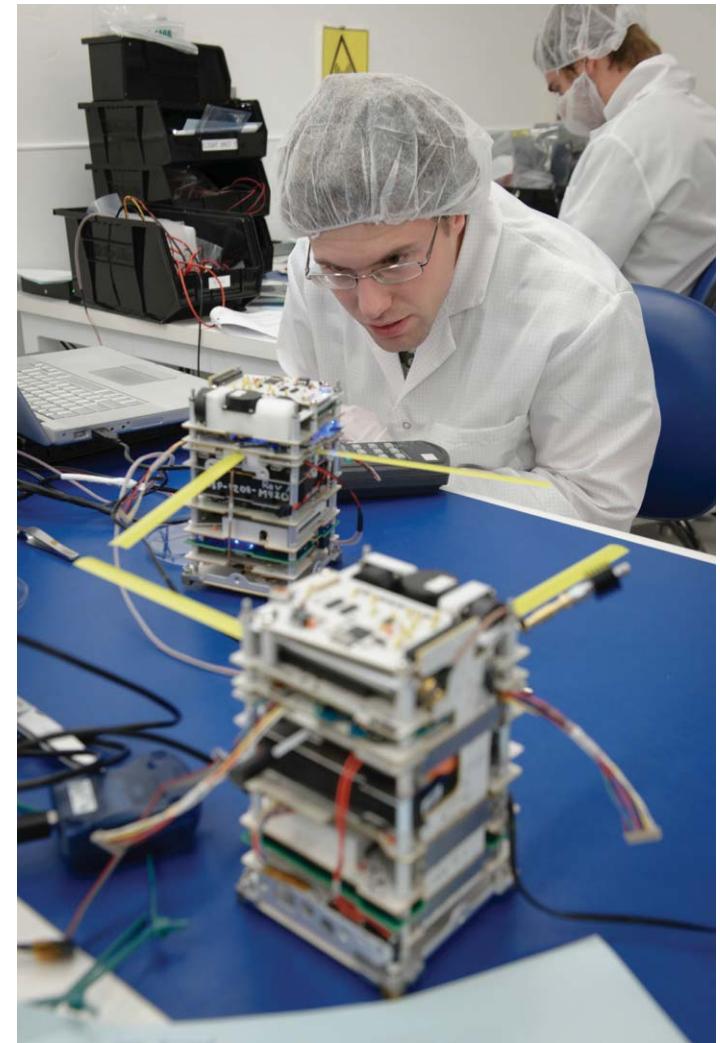


National Aeronautics and
Space Administration



Development Approach

- Technology Demonstration mission
- Decoupled mission objectives
- Multiple attempts at technology demonstration
- Redundancy through number of units
- Autonomous satellite operations
- Consumer grade COTS components
- Concurrent engineering including design, testing & troubleshooting
- Multiple units including DevSats, FlatSats, EDUs & Flight spares
- Focus on testing versus design analysis





National Aeronautics and Space Administration



Development – DevSats & FlatSats

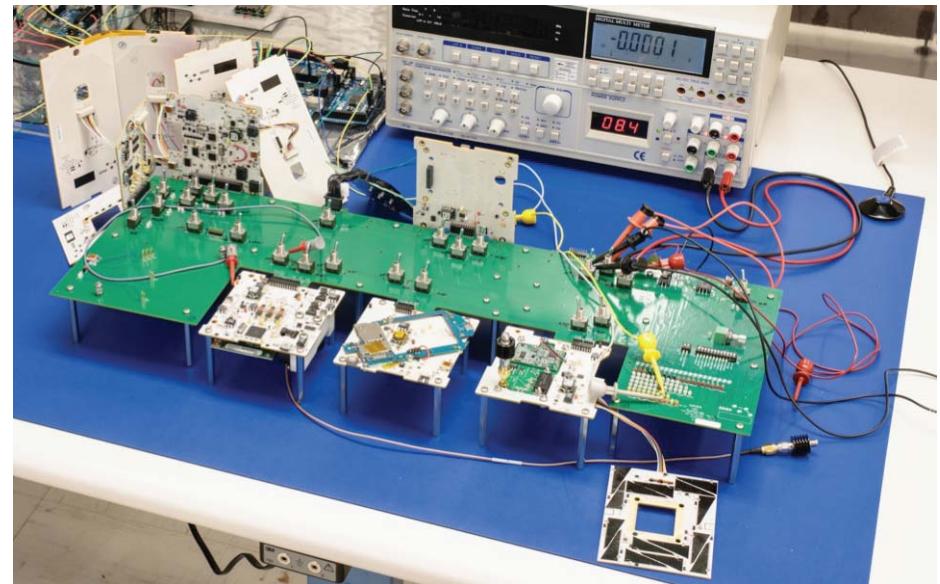
Development Satellites (DevSats)

- COTS development kits
- Identical processors
- Monitor power and data lines
- Rapid and low cost development
- Software development



Flat Satellites (FlatSats)

- Identical PCBs to EDUs
- Reconfigurable
- Turn on/off subassemblies
- Monitor power and data lines
- Allowed rapid repeated testing for multiple PCBs
- Stress testing and characterization





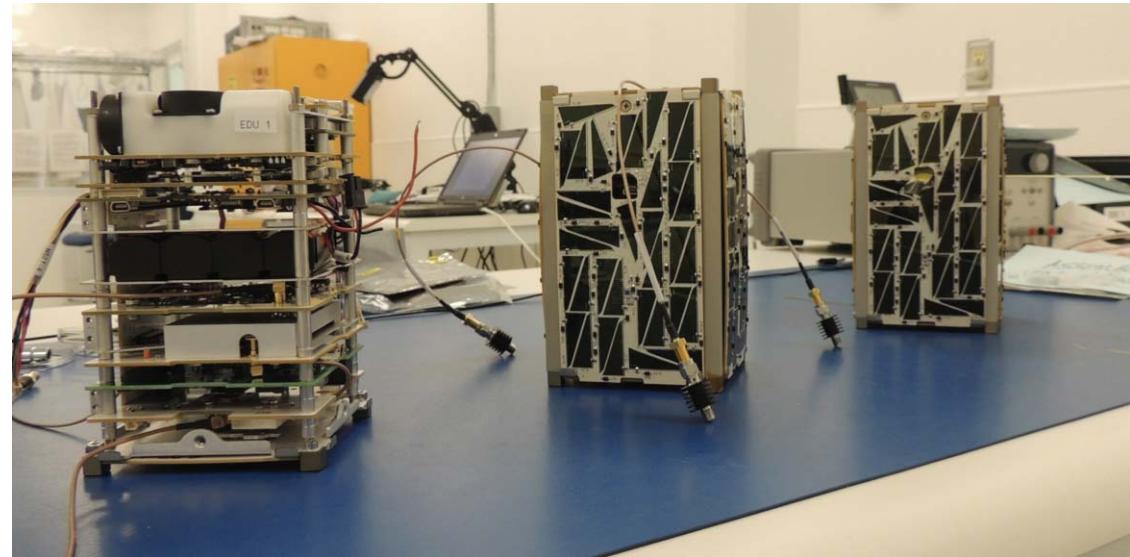
National Aeronautics and
Space Administration



Development – EDUs & Flight

Engineering Development Units (EDUs)

- Early complete satellites
- RF cables on 2 units
- Early Qualification testing
- Software regression testing
- Mission simulation testing
- Risk reduction



Flight Units

- Modifications from EDUs
- Flt 1-2 Qualification
- Flt 3-12 Acceptance Testing
- 10 day Mission Simulation using flight parameters
- Select top 8 units for flight
- Spare flight units





National Aeronautics and
Space Administration



Lessons Learned

- Tracking components and units
 - Paper travellers used required overhead
 - Recommend a more automated system
- Procedures for multiple people
- Procedure detailed tuned to task
- Credible descopes
- Stakeholder involvement
- Renting common GSE equipment
- Combined weekly stakeholder meeting
- Project pace enabled by co-location and daily tags
- Dedicated schedule with daily review and weekly status



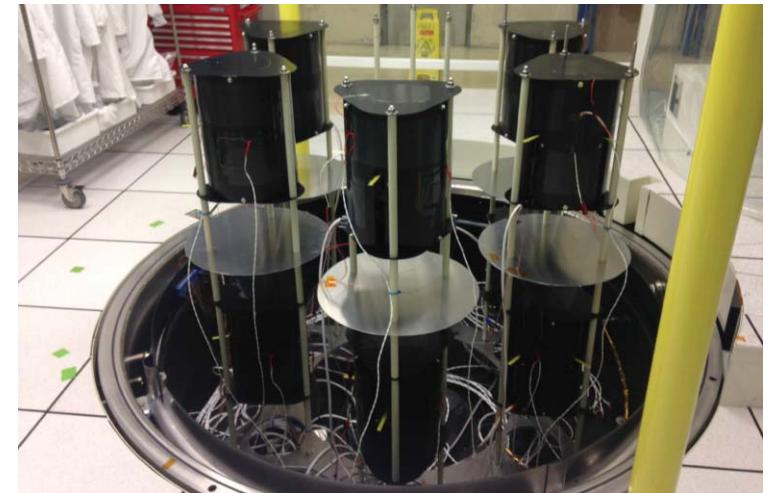
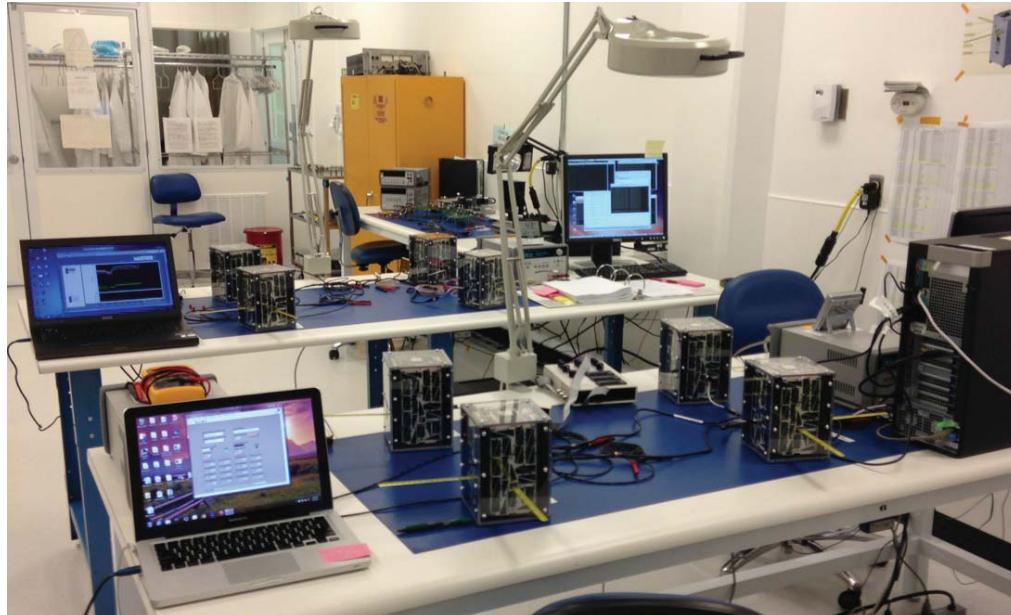


National Aeronautics and
Space Administration



Anomalies and Resolutions

- Workmanship
 - Inspection, buddy system, sparing
- COTS parts
 - Sparing, subassembly testing
 - Connector issues
 - Higher grade Auto/Ind grade
- Connector saver for external ports



- MOSFET issue
 - Internal ESD
 - Known vendors
- Software development tools
 - JIRA Track bugs
 - Regression testing
- DevSats, Flatsat, EDUs
- Ground Support Equipment
 - Account for interaction affects
 - Testing of software



EDSN Development Lessons

- Development of multiple Cubesats is possible and cost effective
- Development approach and processes change
- Configuration Management is essential
- Concurrent engineering required twice as many units
- Testing early and often resolved issues
- Swarms and constellations allow tailoring of risk posture
- Integration and testing of multiple units has additional considerations





Questions?